Can CNG rescue stranded gas reserves for regional power markets?

A look at how CNG can rival LNG for localized power markets – is CNG the poor man’s LNG?

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Will CNG Rescue Stranded Gas Reserves & open up regional power markets?

Between the global excitement about shale gas and the emerging sexiness of LNG (Liquefied Natural Gas), the red-headed step-child of the natural gas industry, namely Compressed Natural Gas or CNG, remains the best possible hope for rescuing so-called “stranded gas reserves” and lighting up under-resourced coastal power markets. Reserves become stranded when they are too far offshore for justifiably economic pipeline construction to bring to land, and too small for a Liquefied Natural Gas (LNG) terminal. One BP estimate puts the global volume of stranded gas reserves (onshore and off-shore) at over 6,000 trillion cubic feet (see Fig 1) – of which about 900 Tcf (almost 40 years of US current consumption) are in offshore gas fields. This figure even excludes the associated gas found lying atop offshore oil fields, which is frequently just flared – a practice that many jurisdictions are regulating against more and more heavily.

Marine CNG could be the ideal solution in areas as diverse as northeast Asia (where gas would come from Russia), the South China Sea (Indonesia, Malaysia, Brunei), the Caribbean (Trinidad could be a major supplier to its neighbors), and West Africa (close to Nigeria and Equatorial Guinea’s gas reserves).

![Trillion cubic feet of stranded natural gas worldwide](image)

**Fig 1: Volume of global stranded gas reserves (courtesy BP)**

When “Cheddy” Sliepcevich, a young chemical engineer of Herzegovinian origin, discovered a way, in 1959, to liquefy and shrink methane gas to one-six-hundredth
(1/600th) of its volume, he had unwittingly launched the world’s LNG industry. His team in fact went on to design the world’s first LNG tanker, and now a quarter of the world’s natural gas is transported in this fashion. But it is a game of very deep pockets.

Today, a typical LNG export terminal requires multiple billion dollars of investment – for example Chevron’s Wheatstone LNG facility in Australia will cost about $29 B to get up and running. LNG facilities require significant gas field sizes of of 5 - 8 Tcf for profitable operation over a 20-year life. On the off-taker side, LNG regasification import facilities generally require gas-fired power plants of up to 5,000 MW to secure adequate returns on capital.

CNG may therefore be the ideal bridge for less cash-flush investors. Instead of exorbitant cryogenic liquefaction, CNG has gas compressed to 1/200th of its ambient standard volume. Since the late 1960’s when the first marine CNG was tested in a New Jersey harbor using a so-called bottle-ship, various advanced storage techniques have emerged to transport ever-larger quantities economically. Canadian firm Cran & Stenning, have developed the “Coselle” (short for “coil in a carousel”), in which a standard 60,000-dwt bulk carrier is converted to carry about 100 such coselles and thereby able to transport about 330 MMcf of gas. Another CNG transport mechanism is the Volume-Optimized Transport & Storage System (Votrans), where the gas is cooled first to 0°F first, then compressed and stored in box-like modules in the Votrans vessel, able to carry up to 1,000 MMcf.

Fig 2: Graphic of Coselle CNG technology (Courtesy coselle.com)
It is in the upfront capital cost where CNG really wins, since loading and off-loading facilities are minimal compared to LNG. Instead of $750-$1B for just the liquefaction part of an LNG facility, CNG requires primarily a compression station at the loading site, and simple jetties or buoys can be used at the off-loading site. One industry average puts the upfront CapEx for a typical LNG facility at more than an order of magnitude difference to CNG. More than 80% of the cost of a CNG system is in the operating cost - in the form of the vessels (a typical Coselle ship would cost $110 - $150M) that ply between the source and destination, and could be redeployed or increased based on need, and which are eminently more flexible than pipelines.

The economics of pipeline, LNG and CNG play off each other depending on volume required at destination, and the travel distance required. Various studies have narrowed down the most economical parameters for CNG to be up to 2,000 miles, transporting for a need of up to 500 MMscf/d (see Fig 4), whereas LNG becomes more economical at greater distances and larger volumes.
The implications of what we see in Fig 4 are powerful. As a feature case, Indonesia, one of the world’s largest exporters of LNG, has about 80 million of its population without access to electricity. As can be expected this has caused frequent incidents of unrest as citizens clamor for their energy to be used at home and with government put under tremendous pressure to ban exports from some projects. In 2008, a paper was presented at the International Petroleum Technology Conference by Wang and Marongiu-Porcu, in which various scenarios of LNG vs CNG were explored. The paper concluded that domestic supply from well-known fields (such as Arun, Botang and Tangguh) would be well-suited via CNG for Jakarta and Bali for demands around 1000 MMcf/d.

![Fig 5: Proposed CNG shipping paths (courtesy USGS)](image)

This amount of gas could provide about 4,000 MW of power – enough for over six million Indonesian homes.

Similar opportunities exist for disconnected and smaller power markets in the Caribbean, where there are major gas producers such as Trinidad and Venezuela which have over 48 Tcf of stranded offshore gas reserves and could feasibly deliver CNG to power-hungry emerging nations such as Jamaica, the Dominican Republic and the Bahamas, as these are well within the 2000-mile radius for which CNG is a winner (see Fig 6).

Indeed the world’s first commercial marine CNG project is poised to come online in the Caribbean shortly, as an announcement in October last year revealed that the way seems clear for UK’s Centrica Energy to sign a deal with the Puerto Rican Electric Power Authority in which they would deliver about 200 MMcf/d from Centrica’s gas field in Trinidad to San Juan almost 1000 km away (see Fig 6) via marine CNG. This is a perfect example of the use of CNG to rescue a stranded reserve and serve an under-resourced
market – Centrica controls 0.6 to 1.3 Tcf of gas north of Tobago, a reserve that would be too small for an LNG plant. Kevin Ramnarine, Trinidad’s vivacious Energy Minister, eager for the project to proceed, has got Centrica to agree to a 2016 date for coming online.

Fig 6: Marine CNG possibilities in the Caribbean – finally becoming reality (courtesy Nikolaou et al, 2009)

None of the super-majors have yet made a foray into marine CNG. Players such as Shell or Chevron are likely still reaping too much value out of larger gas plays to begin to critically examine more niche opportunities which may even fall below their investment thresholds. However, Fig 7 shows the various regions globally in which marine CNG could well hold the key.
Clearly, there are opportunities for savvy private players to carve out specialized and profitable niches in marine CNG. We await with bated breath Centrica’s leadership into these waters as it may be just what is required to jumpstart the industry and open up exciting new regional power markets.

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